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Wind power development in Sweden: Global policies and local obstacles ☆

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Abstract

Recently, the Swedish government adopted a national planning goal of a yearly wind power generation of 10 TWh by 2015, implying a substantial increase from the current 0.6 TWh level. In this paper, we provide an economic assessment of the potential for future wind power investments in Sweden in close conjunction with an analysis of the legal, attitudinal and policy-related uncertainties that face a wind mill investor. It is shown that the economics of Swedish wind power is negatively affected by: (a) the lack of policy stability; (b) public criticism at the local level; and, in particular, (c) the legal provisions governing the assessment of the environmental impacts of wind mills and the planning procedures for mill location. While national and global energy policies as well as the general public point out wind power as particularly environmentally friendly, most of the objections to its expansion at the local level tend to have environmental origins. The interests of those who object to wind mill installations gain strong legal protection, and the municipal territorial planning monopoly in Sweden implies that it is hard to make national energy policy goals heard at the local implementation stage. Compared to its competitors, wind power is the technology that tends to have the most to loose from the risk and uncertainties created by this investment environment. The paper identifies and discusses a number of ways in which the national policy interests could be strengthened at the local level. We discuss the role of citizen participation, as well as solutions within the realms of the legal system. Moreover, since the diffusion of wind power encounters the most strident legal and

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attitudinal obstacles where it interferes with competing land uses, a move offshore appears to be an efficient strategy from the perspective of a wind mill investor. A stronger political commitment to wind power expansion in legal provisions as well as in the form of long-run stability in policy instrument implementation will probably be necessary to attain the 2015 policy goal.

Contents

1. Introduction

In a number of decisions on the national energy policy since 1975, the Swedish Parliament has established the long-term objective of converting from the exploitation and use of non-renewable energy resources, in particular, fossil fuels and uranium, to increased use of renewable energy resources such as wind power and biomass. These policy objectives are well in line with the European Union's current goal to increase the share of renewable electric power to 22% in 2010 compared to 14% in 1997 (Directive 2001/77/EC). During the 1970s, the Swedish governmental support of renewable energy was spurred mainly by the desire to decrease the reliance on expensive oil imports. As of today, though, the benign environmental attributes of renewable energy—in particular its negligible contribution to global carbon emissions—and the political goal to phase out nuclear power partly motivate the introduction of R&D support as well as different subsidies for wind power (see also Section 2). Still, in spite of these policy goals and

measures the development of wind power—although it appears to be one of the most attractive renewable power sources in terms of both cost development and environmental impacts [1]—has been considerably more modest in Sweden compared to countries such as Denmark, Germany and Spain (IEA, annual).

The main purpose of this paper is to analyze the potential for future wind power development in Sweden, with special emphasis on what constitutes the main obstacles to further diffusion of wind mills in the country's electric power sector. Methodologically, we approach this issue from the perspective of a power generator who considers investing in new wind mills. This implies that we first of all assess the lifetime engineering costs of different power generation technologies in Sweden, and analyze the impact of the different policy instruments in use on the competitive cost position of these technologies under varying rate-of-return requirements. We also, however, recognize that the investment decision (not the least the investment costs) will be influenced by the existence of—and the uncertainties related to: (a) public resistance towards planned wind mills; and (b) the legal frameworks conditioning the planning, location and use of wind mills. The paper, therefore, also draws on the results from a postal survey sent out to 1000 Swedish home owners including questions about their attitudes towards wind power in general, and a so-called choice experiment designed to elicit how the respondents perceive the different attributes of wind mills and parks of wind mills (e.g. location, height, noise, etc.). In addition, the paper provides an analysis of important legal provisions and case law examples concerning the assessment of the environmental impacts of wind mills and the planning procedures for mill location in Sweden. This cross-disciplinary approach should permit us to gain a comparably comprehensive understanding of the economic, political, and legal conditions that face a wind mill investor.

The relatively slow development of wind power in Sweden has been analyzed in other studies.[1] What is common for many of these is the reliance on systems-based approaches in the analysis of technology diffusion patterns in the wind power sector. Bergek [2] and Bergek and Jacobsson [2,3] rely on a so-called innovation systems approach in which technology diffusion is the outcome—not of individual firm decisions—but of the relationships between the actors, markets, networks and legal rules that together make up the 'wind power innovation system'. Åstrand [4] and Åstrand and Neij [5,6] employ a related approach and derive a number of assessment criteria for the evaluation of technology diffusion, and use these to analyze the development of wind power in Sweden. A typical conclusion—or rather a maintained hypothesis—in these types of studies is that: "technology diffusion [is] dependent on the innovation system as a whole, and policy and strategy should, therefore, not be limited to the individual parts of the system," [2, p. iii]. Largely, the above studies explain the modest development of Swedish wind power generation by referring to the failure of the Swedish 'innovation system' to develop a competitive wind turbine industry, as well as to the ambiguous and weak Swedish policy towards wind power.

Following another research tradition, Unger [7], Unger and Ahlgren [8] and Rydén [9] employ the bottom-up energy systems model MARKAL and analyze the future development of the Nordic energy system in the presence of different climate and renewable energy policies. The analysis of the future economic potential for wind power in

[1]For additional country studies of wind power development, see, for instance, [61] (USA), [62] (Spain), and [63] (The Netherlands).

Sweden and in the other Nordic countries represents an important part of this research. One important result is that in the long-run (10–20 years) a green certificate system for renewable power generation will induce a considerable expansion of wind power in Sweden. While this type of model work is very useful for studying technology choice under different policy scenarios—not the least given its detailed representation of available energy technologies and their costs—it is limited in its characterization of institutional obstacles to new investment. In addition, perfect foresight in the investment decision process is typically assumed.

The present study adds to the existing knowledge about wind power development in Sweden in a number of ways. The adopted power generator eye-view of the investment decision process enables us to analyze explicitly the different types of economic, legal and political uncertainties that face a wind mill investor in Sweden, and point to measures that can be implemented to reduce these uncertainties. Moreover, while systems-based approaches tend to stress the importance of the 'wind power system' as a whole rather than its parts, we argue that there are single factors affecting the investment decision that represent more significant obstacles to future diffusion than do other factors. Specifically, we emphasize that while the policy instruments that are implemented at the national level are, generally, sufficiently strong to induce investments in wind power, the environmental goals that motivate the use of these policy instruments are not always visualized at the local planning and permitting stage. This suggests that—although public support to wind power is motivated—the introduction of new policy instruments or the modification of existing ones should be preceded by an evaluation of the institutional framework governing wind power development.

The paper proceeds as follows. Section 2 summarizes the role of wind power in Swedish energy policy and outlines the different policy instruments that are used to promote the diffusion of wind mill installations. The remainder of the paper presents the results from the empirical investigations: the economics of wind power in Sweden and the impact of different policy instruments on its competitive position compared to other power technologies (Section 3); public attitudes towards wind power in general as well as towards its specific attributes in particular (Section 4); legal issues conditioning the assessment of the environmental and health impacts of wind mills as well as the legislative framework for land-use planning in Sweden (Section 5). Finally, Section 6 highlights in more detail the underlying conflict between global/national energy policy goals on the one hand and the local implementation of wind power expansion, while on the other, Section 7 provides some brief concluding remarks and implications.

2. Wind power and Swedish energy policy[2]

Following the oil crises in the 1970s, Swedish energy policy began to promote the efficient use of energy and the diffusion of renewable energy resources, mainly as a way of reducing the dependence on imported oil. The Swedish nuclear referendum in 1980, which resulted in the decision to gradually phase out nuclear power, motivated further support of renewable energy. To achieve this objective, public R&D support, including a wind energy research program, was initiated. However, this support had little impact on the diffusion of wind power in Sweden during the 1980s, and it was first with the introduction of

[2]For a more detailed overview of Swedish wind power policy since the 1970s, see [5].

Table 1
Electric power supply by source in Sweden, selected years

Electric power sources	1994		1996		1998		2000		2002	
	%	TWh	%	TWh	%	TWh	%	TWh	%	TWh
Hydro power	58.2	40.1	51.1	33.5	73.8	45.5	77.8	48.6	65.8	40.3
Nuclear power	70.1	48.3	71.4	46.9	70.5	43.9	54.8	34.2	65.6	40.2
Thermal power	10.0	6.9	13.9	9.1	9.9	6.2	8.8	5.5	11.3	6.9
Wind power	0.1	0.01	0.2	0.1	0.3	0.2	0.5	0.3	0.6	0.4
Total power generated	138.4		136.5		154.6		141.9		143.2	
Imports	6.7	4.6	15.9	10.4	6.1	3.8	18.3	11.4	20.1	12.3
Total power supply	145.1	100.0	152.4	100.0	160.6	100.0	160.2	100.0	163.3	100.0

Sources: Statistics Sweden and Swedish Energy Agency [20,30,41,53].

complementing policy programs in the early 1990s that significant wind power investments took off. The 1991 energy policy bill initiated a transition of the Swedish energy system, and increased reliance on renewable energy constituted a central component of this program [10]. In another bill from 1991, the favourable conditions for wind power in Sweden are stressed and renewable energy is assigned an important role in the work towards fulfilling the 15 environmental quality goals of Sweden, including those related to climate policy [11]. The energy policy bills from 1997 and 2002 have together provided an additional push for this policy, and short- and longterm goals for wind power have been introduced [12,13]. Most importantly, in 2002, a national planning goal of a yearly wind power generation of 10 TWh by 2015 was adopted. As noted by [4], before this planning goal was introduced: "the goals specified in Sweden's wind power policy [were] characterized by soft formulations stating that wind power shall be introduced and spread in the Swedish energy system, without explicitly stating when and how much," (p. 239).

Following the above political intentions, a number of policy incentives were introduced during the 1990s to encourage wind power development. These included additional R&D programs (e.g. the so-called Energy Technology Fund), investment subsidies (ranging between 10 and 35% of investment costs), and a production subsidy (the so-called 'environmental bonus', which in 2003 amounted to SEK 0.18 per kWh) [14]. In 2002, a temporary production subsidy,SEK0.09 perkWh,wasalso introduced for small-scalepower generation (including wind power). Largely, as a result of these policy instruments, wind power production increased by over 700% over the time period 1994–2002 (see Table 1), albeitfroma very low level. In spite of this increase,however, in 2002the share ofdomestically generated wind power out of total Swedish electric power supply was only about 0.4%. This corresponds to a power generation of about 0.6 TWh, far below the 2015 goal.[3]

By international comparison the Swedish policy towards promoting wind power cannot be considered a success. Fig. 1 displays the development of wind power capacity in Sweden and in four other European countries. The wind power diffusion record appears to be very

[3][57] report that in 2003 about 600 wind mills were installed in Sweden, and depending on size, efficiency etc. about 3000–10000 wind mills would be required in order to reach the goal of 10 TWh by the year 2015.

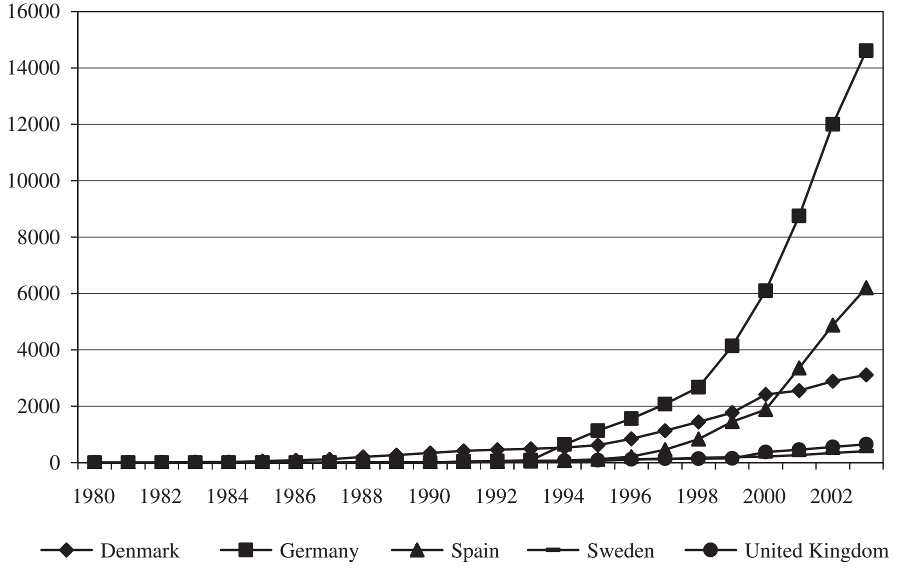


Fig. 1. Installed wind power capacity in selected European countries (mw). *Source*: International Energy Agency (annual) [60].

mixed when compared across countries. Denmark, Germany, and more recently Spain, have experienced considerable growths in the installed capacities of wind mills, while the corresponding developments in Sweden and the United Kingdom have been much more modest. This mixed picture—including the slow development in Sweden—can only to a limited extent be explained by the strength and the design of implemented policy instruments as such [15,16]. In addition, wind conditions are no worse in Sweden compared to, say, Denmark or Germany, and modern wind turbines can be bought on the global market (most notably from Denmark). However, what does appear to differ between the countries is the consistency with which the national wind power policies have been implemented. The economic and policy-related uncertainties that face a wind mill investor vary heavily across countries in terms of both type and size; so does the public's view towards wind power development and the legal possibilities to hinder wind mill installations at the local level [17]. The Swedish wind power policy has in these respects been considered too erratic and irresolute [2,5], and such concerns have gained additional fuel with the recent introduction of a new public support system for renewable power generation.

In May 2003, a green certificate system for renewable energy was introduced, and its aim has been to secure a pre-determined market share for renewable power sources but also to promote competition between the different types of renewable energy sources [18]. Generators of renewable power are awarded a certificate for every MWh they generate. These can then be sold and the users are obliged by law to purchase certificates that correspond to a certain percentage of their electricity consumption. This quota obligation will increase annually, and the goal is to increase the amount of renewable power by 10 TWh until the year 2010. This implies, for instance, that a wind power producer will in addition to the wholesale price of electricity also receive a price for any certificates sold.

Since only low-cost generators will be able to sell their certificates, the system will, at least in theory, provide renewable energy at minimum costs [19]. The new system has replaced previous investment subsidy programs and will gradually replace the 'environmental bonus', which will be lowered annually and (in the case of onshore wind power) be completely abandoned in 2010. During 2004, the Swedish green certificate system was evaluated [20], and one of the main conclusion is that the new system's ability to promote new investment in wind mills has been limited.

Moreover, in the past no carbon tax has been paid for fuels used in the Swedish power sector. However, with the introduction of trade in emission allowances for carbon dioxide, which took off in the European Union in January 2005, also power-related carbon emissions carry a price. Some 500 plants in the energy sector and in the energy-intensive industries in Sweden form part of system, and have been awarded emission allowances corresponding to about 17–18 million tonnes of carbon dioxide [21, p. 62]. This new policy will create a further stimulus to investment in renewable power sources, but it is still unclear at what level the price of carbon allowances will settle in the long run.

The so far modest development of wind power in Sweden, the ambitious goal of 10 TWh wind power by 2015, as well as the recent changes in the policy incentive structure together motivate a study of the current and future market conditions that face a wind mill investor. This section has also indicated that a comprehensive analysis of the prospects for future wind power development must not only address the relative costs of wind power generation and the impact of the different policy instruments on these costs. It must also deal with the uncertainties that are created by the regulatory and legal systems as well as the impact of public perception of wind power.

3. The economics of wind power and the impact of policy instruments

3.1. Brief remarks on the assessment of power generation costs

A comparison of the economic merits of different power generation technologies requires the use of a project appraisal technique, of which the discounted cash flow technique is the most commonly used. One surrogate often used in the power generation sector (both by regulated and unregulated utilities) is the levelized (lifetime) cost (*LC*) methodology. Here, all power generation costs of new investment—capital, operation and maintenance, fuel costs—are discounted to a present value and then divided by the total discounted output over the economic lifetime of the plant [22,23]. The *LC* method results thus in an average cost per unit of electricity produced. It should be noted that the cost estimates generated by this method represent what may be referred to as engineering costs; that is, the cost is an attribute of the technology rather than an attribute of the context within which the technology is applied [24]. The cost assessment must, therefore, be complemented with an analysis of the institutional obstacles that face investors. In the paper, 'institutions' are understood broadly to be the 'rules' of political and economic life. These may be both formal (laws, regulations etc.) and informal (norms of behaviour, attitudes etc.) (see, in particular, [25]).

In practice, the uncertainties that face an investor will differ depending on a number of factors; policy support, public opposition, permitting procedures, prices, etc. The more significant these financial uncertainties are, the higher the rate-of-return requirement (i.e. discount rate) will be. For instance, capital asset pricing models (CAPM) include

Table 2
Generation costs for new power plants in Sweden

Plant type	Capacity (MW)	Levelized cost SEK per kWh)[a]	
		Without taxes and subsidies	With taxes and subsidies
Coal—power plant	400	0.39	0.43
Coal—CHP	100	0.30	0.79
Gas—power plant	400	0.30	0.31
Gas—CHP	150	0.31	0.46
Biofuel—CHP	80	0.40	0.24
Wind power—onshore	20	0.38	0.20
Wind power—offshore	90	0.41	0.23
Hydropower—low		0.23	0.23
Hydropower—high		0.36	0.36

[a]The levelized cost estimates are based on the use of a 6% discount rate and an economic lifetime of 20 years (except for hydropower for which the economic lifetime is assumed to be 40 years). Source: [14].

a riskfree rate-of-return plus a risk premium that reflects the undiversifiable risk of similar investments.[4] The impact of higher uncertainties and risks will differ depending also on the cost structure of the technology; in general, it can be asserted that technologies for which the capital costs form a sizeable part of total levelized costs will suffer comparatively much from the use of higher discount rates. The important research task in this section is to examine the role of project uncertainty and policy support on the economics of Swedish wind power.

Specifically, the analysis provides an assessment of the economic costs of the most important competitors to wind power, and attempts to determine what level of public support is required to equalize the generation costs of wind with some cheap benchmark alternative (see further Section 3.2). Given our focus on perceived investment uncertainties and the resulting rate-of-return requirements, we perform the analysis for different discount rates.

3.2. The competitive cost position of wind power in Sweden

Although the costs of producing wind power has declined substantially during the last two decades [16,26], public support is still generally needed to make investments in wind mills commercially attractive. Table 2 summarizes levelized cost estimates for different new power generation technologies in Sweden (for commissioning in 2003) as reported by the Swedish electricity research institute Elforsk, including one onshore and one offshore wind power alternative. The costs for wind power include all investment costs (turbine, electrical installations, foundation, etc.), but ignore the highly site-specific costs related to

[4]It is worth noting that the standard rate-of-return requirements may differ between private generators (e.g. 10%) and utilities owned by the state or by local governments (e.g. 5%). For instance, for a state-owned utility, the state can choose to accept lower returns or provide direct financial support in the case of unexpected cost escalations. This implies that although the presence of risk will harm investment for both private and state-owned companies, the importance of this effect is probably higher in the former case. In Sweden, both categories of investors exist.

connections to the electric grid.[5] The costs for producing hydropower also tend to vary significantly depending on location and for this reason two estimates are presented, where the actual cost is assumed to lie somewhere between these two extremes.[6] Overall the cost figures show that in the absence of taxes and subsidies, gas-, coal- and some hydro-based power are the cheapest alternatives. Still, further development of new large-scale hydropower is strongly restricted according to Swedish law, and on a private cost basis gas-fired power (combined cycle gas turbines) is likely to be favoured over coal.

The combined cycle gas turbine (CCGT) possesses—in contrast to nuclear energy and coal-fired power—many of the characteristics suitable in times of deregulation and slow demand growth. Most importantly, low capital costs, short lead times, and the possibility of adding small capacity increments, enable power producers to follow demand developments more closely, and reduce uncertainties and costs [27]. The recent decision of the Swedish power company Göteborg Energi to invest in a gas-fired power station using Norwegian gas illustrates the favourable economics of the gas alternative—at least when the infrastructure for transporting the gas is at place [28]. The above motivates the use of gas-fired power as a benchmark towards which the economics of wind power can be assessed.

Table 2 shows that on the basis of a private cost comparison, wind power—neither offshore nor onshore—is an economically viable alternative. However, when existing taxes and subsidies are added and subtracted from the private costs the competitive positions, generally, change in favour of wind power. Specifically, the far right column in Table 2 shows the different levelized costs after: (a) an electricity certificate price of SEK 0.15 per kWh and the discounted value of the future time-declining environmental bonus have been subtracted from the wind power costs; and (b) the taxes charged on sulphur and nitrogen emissions have been added to the fossil-fuelled power generation alternatives (see [14], for details).[7] As a result of the policies implemented, wind power appears to be one of the most attractive new power generation investments in Sweden.

Still, the above engineering cost figures build on specific assumptions about discount rates, subsidy levels, and they thus also neglect the role of different uncertainties related to the policies and institutional frameworks that govern wind power development. In the remainder of this section, we analyze, therefore, the impacts of policy instruments and the use of different rate-of-return requirements on the relative cost structure of wind power. As was noted above, the levelized cost of gas-fired power generation serves as a benchmark in this analysis. The impacts of the two most important policy instruments that will affect the future of wind power in Sweden are examined; the system of tradable emission rights for carbon dioxide and the green certificate system.

[5]This is not an unimportant limitation of the analysis. In Sweden, wind power is sometimes constrained by the fact that local grids need to be reinforced before they can deploy new wind power.

[6]Since the Swedish government has decided to gradually phase out nuclear power and thus no *new* nuclear plants are planned, this option is not included here.

[7]As was noted in Section 2, in Sweden no energy or carbon dioxide taxes are currently charged on fossil fuels used for power generation. However, for fossil fuels used for heat production in combined heat and power (CHP) facilities a 50 percent energy tax and a full carbon dioxide tax are paid. This explains, for instance, why the economics of the CHP alternatives change so drastically when existing taxes and subsides are taken into account.

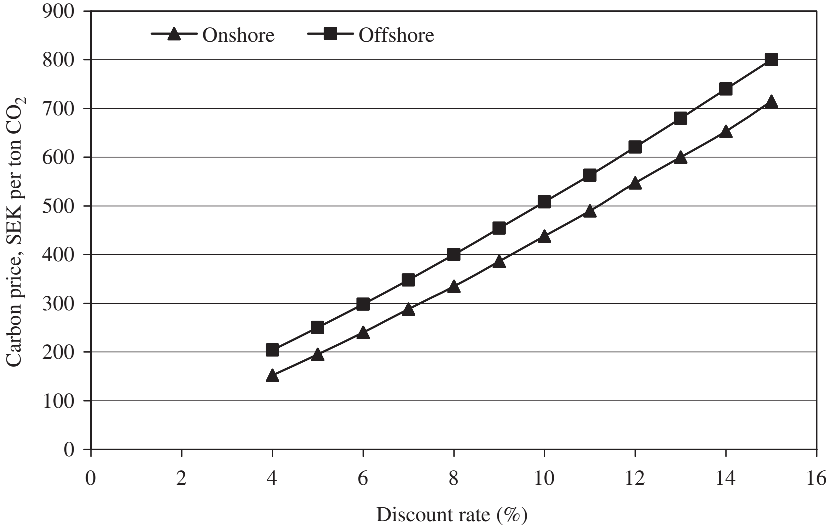


Fig. 2. Carbon prices required to equalize the cost of wind power with gas-fired power.

3.3. The policy impacts on the competitive cost position for wind power

The question we first ask ourselves in this section is what levels of the allowance price of carbon and the green certificate price, respectively, are required to equalize the levelized cost of wind power with that of gas-fired power for different discount rates. The results from these simulations are displayed in Figs. 2 and 3.

Fig. 2 shows the impact of different carbon prices on the relative costs of wind versus gas-fired power (ignoring, for the moment, the impact of green certificate prices). For instance, assuming an 8% discount rate, a carbon price of SEK 400 per ton carbon dioxide is required to put offshore wind power on equal footing with gas-fired power, while the corresponding 'break-even' price for onshore wind power is SEK 335 per ton carbon dioxide. The current plan for an EU-wide system for tradable carbon dioxide allowances (following the Kyoto commitment) implies that the European Union and Sweden in part attain their adopted emission reduction targets by means of internal emission reductions or purchases of intra-EU emission allowances valid for the energy, iron and steel, oil refineries and pulp and paper industries [21, p. 62]. The other sectors of the economy (e.g. transport) will not form part of the allowance market but will instead face other carbon-related policy instruments (e.g. taxes). The price of carbon dioxide allowances will depend, of course, on the total emission cap assigned to the trading sector, but most analysts tend to agree that the market will be quite thin and prices are (at least initially) unlikely to be higher than SEK 200 per ton carbon dioxide. For instance, Bergman and Radetzki [29] presented model simulations of such sectoral trade within the European Union indicating a Swedish carbon price of about EUR 17—corresponding to about SEK 158—per ton carbon dioxide. Fig. 2 shows that at such a price, wind power will only be competitive compared to gas at very low discount rates ($r < 4\%$); only if the trade is expanded to other sectors and/or a stricter cap on total emissions is introduced, the

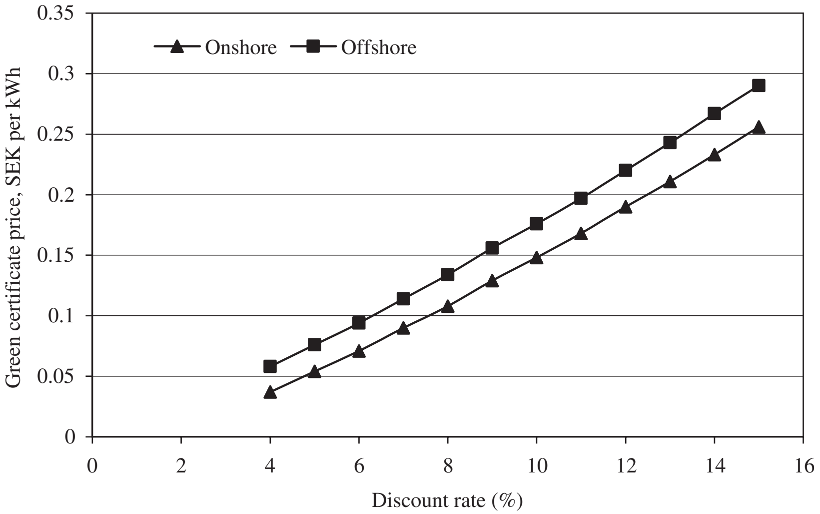


Fig. 3. Green certificate prices required to equalize the cost of wind power with gas-fired power.

tradable allowance system alone would provide a sufficiently strong policy instrument to put wind power on equal footing with gas-fired power.[8]

An important result is also that wind power looses competitive ground from the use of higher discount rates; for each percentage unit increase in the discount rate the carbon price needs to increase by about SEK 60 per ton for the equality between wind and gas-fired power costs to still hold. This is a result of the fact that the capital costs involved in wind power development form a sizeable part of the total levelized costs, and the higher are the uncertainties about the future rate of return of the investment the less competitive wind power will be. Gas-fired power, on the other hand, is less capital intensive and will benefit from higher discount rates and thus from increased uncertainties about market and policy developments, and about the outcome of the planning and permitting procedures. This shows that one very crucial prerequisite for the successful diffusion of wind power is to reduce these types of uncertainties.

This conclusion can also be derived from the results in Fig. 3, which displays that as the discount rate increases the higher the green certificate price needs to be in order to maintain the competitive position of wind versus gas-fired power. However, Fig. 3 also shows that overall the green certificate system has provided a strong economic stimulus to wind power. The average certificate price over the time period September 2003 to September 2004 was SEK 0.22 per kWh [30], and at such prices wind power will be cost competitive compared to gas-fired power even at relatively high discount rates ($r<12\%$). Still, the certificate system is connected with a number of uncertainties—such as price fluctuations—implying that the risk-adjusted discount rate may be high. Most importantly perhaps, while the economic time horizon of a wind mill project generally is about 20 years, the green certificate system has a much more limited time horizon; it will exist at

[8]The model simulations outlined in [29] indicate that if all sectors are included in the EU-wide allowance system, the price per ton of carbon dioxide allowances will equal EUR 36, i.e., about SEK 330.

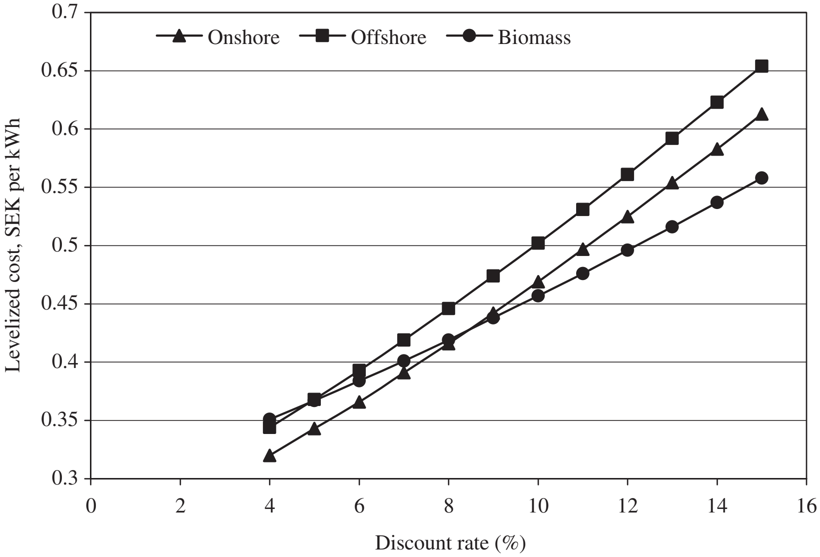


Fig. 4. Levelized cost estimates for wind and biofueled power (CHP) for different discount rates.

least until the year 2010, but after that it is still unclear what will follow. This signals a lack of political commitment and increases the economic risks faced by investors.

The green certificate system does secure a given market share for renewable power, but also promotes competition between different renewable power sources. For this reason, it is useful to compare the economics of new wind power also with that of its most important *renewable* competitor, bio-fuelled power. Fig. 4 shows how the levelized costs of onshore and offshore wind power vary with the discount rate used, and compares this to the corresponding cost for a new bio-fuelled CHP plant. An important conclusion from this figure is that, just as in the CCGT comparison, wind power looses competitive ground with the use of higher rate-of-return requirements and thus when uncertainties are high.

It is also worth noting that renewable power alternatives that involve investments—and resulting production increases—in *existing* capacity are eligible for certificates; these include, for instance, the substitution of biomass for coal in existing CHP plants and the upgrading of existing hydropower. These are low-risk alternatives that will be particularly attractive in the presence of major uncertainties about future policies, economic conditions and institutional constraints. The main advantage of these options lies in the fact that the investment costs of the existing plants are sunk, and they will compete with new capacity largely on the basis of their variable costs. The greater the difference between the total cost of a new plant and the variable cost of an existing plant, the greater the incentive for better and more intense use of the existing plant. This is typically the case in Sweden when new wind power competes with existing hydropower or nuclear energy. The interest in upgrading existing hydropower in Sweden is currently very high among Swedish power producers with the introduction of the certificate system, and it is estimated that production increases of about 2–3% may be economical [31].[9]

[9] A similar development is taking place in the Swedish nuclear industry; here 600 MW of capacity has been added incrementally by improving the use of existing plants ([64]).

3.4. Final comments on the economics of Swedish wind power

The analysis in this section has indicated that under normal rate-of-return requirements the policy instruments used (and planned) in the Swedish power generation sector should generally be strong enough to promote new investment in wind power. It should also be added that the current (long-run) electricity price tends to be high enough to induce such new investment. However, from an investor's point of view Swedish wind power has two related economic disadvantages. The first one is associated with the fact that future wind power expansion requires *new* investment on new sites, while the current economic environment tends to favour investments in—and intensified use of—*existing* capacity at existing sites. This introduces a large degree of path dependence in the energy system, and harms all new investments in power generation technologies in Sweden (including also CCGT). However, the second disadvantage is that when wind power competes with other new power projects, the economic outcome for wind power is particularly sensitive to uncertainties about future policies, prices, and regulations.[10] Thus, one of the most efficient means of promoting wind power is most likely to reduce these uncertainties (e.g. extend the time horizon of the green certificate system), rather than to provide *additional* economic incentives by introducing new policy instruments or strengthening existing ones. The remainder of this paper analyzes important uncertainties related to: (a) public resistance towards planned wind mills; and (b) the legal framework conditioning the planning, location and use of wind mills, which in combination, we argue, represent the most significant obstacles to the future development of wind power in Sweden.

4. The public's attitudes towards wind power in Sweden

The occurrence of local resistance towards planned and existing wind mill farms is often referred to as an important obstacle to increased wind power capacity in Sweden and elsewhere [17]. "No to wind turbines in the mountains," "Wind power should be in the south," and "Stop the spinning madness," are all relatively recent headings found in Swedish daily newspapers [32–34]. Essentially, they illustrate prevailing local resistance towards planned wind power schemes in different parts of Sweden. Reasons given are, for instance, visual intrusion, noise, and land devaluation. However, in spite of the existence of local opposition the experiences in Sweden (and in many other countries) are that lay people, generally, express a positive attitude towards wind power [35]. Several valuation studies also demonstrate a non-negligible market potential in Sweden for 'green' electricity such as wind and hydropower [1,36,37].

Given the, generally, positive attitudes towards wind power, the occurrence of local resistance towards wind power developments is typically explained by the so-called Not-In-My-BackYard (NIMBY) syndrome.[11] This explanation has however been criticized for being too simplistic [38]. Wolsink [39] claims that the expression of NIMBY behaviour is at most only a secondary issue for people opposing local wind power projects. Instead local

[10]This contradicts the commonly used argument that renewable power is more flexible than the traditional power technologies and should benefit from uncertain market conditions. See, for instance, [65], who state that 'renewable energies show advantages due to their modular character and their ability to add new capacity incrementally and adjustably to the current energy demand,' (p. 297).

[11]The NIMBY syndrome, as a concept, here illustrates people who may well accept the policy that wind mills should be sited somewhere, but who refrain from the idea of having them sited in their town or neighbourhood.

resistance may often express suspicion towards the people or the company who wants to install the turbines or a rejection of the process underlying the decision to build new plants rather than a rejection of the wind mills as such. Wolsink concludes that such institutional constraints are crucial and that open collaborative approaches, initiated by both political actors and wind power developers, are of major importance for the build-up of what he refers to as 'institutional capital' in the wind power sector. Results from interviews with people living close to wind power installations in the south of Sweden also emphasize the role of collaborative approaches and the benefits of involving the local population in the early stages of the planning of wind mills [40,41].

In a study on public attitudes towards wind farms in Scotland, the author concludes that the attitudes of local residents towards adjacent wind facilities were generally positive [42]. Although about 27% of the respondents had expected the landscape to be spoilt by the wind mill farm only 5% maintained this view after the development of the farm. Generally, the proportion of respondents who anticipated various problems before the developmentwas significantly higher (40%) than the proportion that actually experienced problems as a result of the investment (9%) [42]. These results support the existence of the NIMBYsyndrome prior to the construction of the mills, but they also illustrate, we argue, that this problem could have been partly overcome through a closer collaboration between the power generator, the authorities and the community. As was noted above, several of those who anticipate problems *ex ante* may well express a lack of trust in the power company or oppose the way the project is planned rather than oppose the installations as such. They may also be uninformed about the expected impacts of the construction.

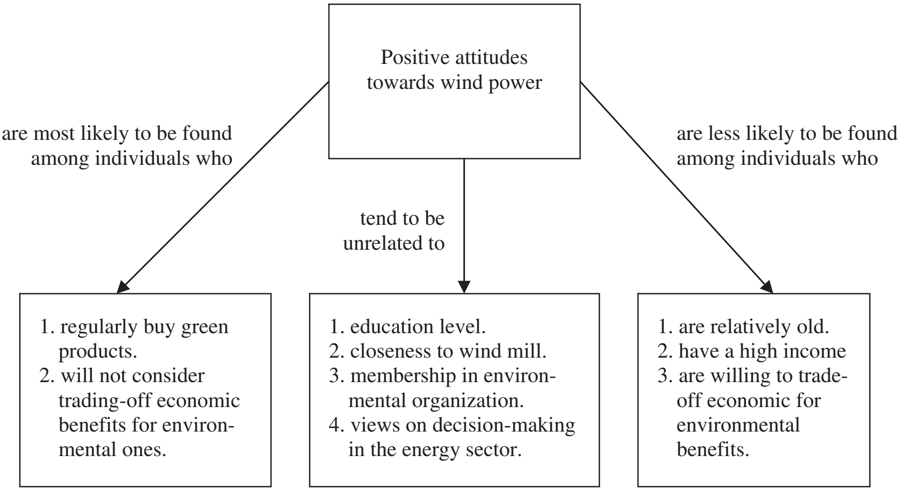
The above illustrates the importance of analyzing public attitudes towards wind power in close conjunction with the legal and institutional frameworks that affect the development of wind power. Legal rules for wind power siting (as well as resulting court decisions) generally aims at finding a proper balance between different interests in society, and they will, therefore, largely determine the extent to which any negative opposition will influence wind power siting decisions. In this section, we add to the empirical evidence on the public's attitudes towards wind power in Sweden, while Section 5 focuses on the relevant legal provisions that govern wind power development.

In 2002, a questionnaire was sent out to 1000 Swedish house owners. The main objective of the survey was to analyze the attitudes towards wind energy in general (Section 4.1), and the perception of the different attributes of wind power in particular (Section 4.2). The overall response rate was 56%.[12] The reason for limiting the survey solely to people living in owner occupied houses is that all these households have the possibility to choose electricity supplier. If they consider wind power to be a preferable product, for instance due to its environmental characteristics, they can make an active choice to buy wind electricity. Consequently, Swedish house owners have the potential to constitute a significant share of the domestic demand for wind electricity.

4.1. General attitudes towards wind power

In the questionnaire, the respondents were asked about their general attitude towards wind power. They were told to mark their attitude on a scale ranging between 1 and 5

[12]The questionnaire was developed by using the experiences from: (a) an early test on a group of graduate students; (b) a pretest involving about 30 respondents; and (c) two focus group deliberations. See [36] for details.



* The variables that are outlined here as having an actual impact (whether negative or positive) on the prevalence of positive attitudes towards wind power, are those whose coefficients in the logit model were found to be statistically significant at the 10 percent level (or higher). See Ek (2002, 2005) for details.

Fig. 5. Determinants of General Public Attitudes towards Wind Power in Sweden*.

(where 1 was labelled as 'negative', 5 as 'positive' and 3 as 'neither negative nor positive'), Those who did not have any opinion or did not simply know were told to mark this explicitly; only 2% of the respondents chose this option, though. A clear majority of the respondents took a positive stance positive towards wind power. Only 10% of the respondents expressed a negative stance—1 or 2—while 64% chose the positive alternatives—4 or 5 (and 23% expressed a 'neutral' attitude—3).[13] 13 These results are overall consistent with those reported by Krohn and Damborg [35]. It is important to note, though, that this general support for wind energy is expressed among individuals who may not themselves be affected by wind mills (neither existing nor planned). In a recent study on Björkön, near Sundsvall in mid-Sweden, where a wind farm is planned, the support for wind power was found to be somewhat weaker. Forty-seven percent of the residents stated that they were generally positive while 28% stated that they were generally negative towards wind power [43].

We also analyze whether the likelihood for an individual to state that she is positive towards wind power differs with respect to different attitudinal and socioeconomic variables by applying a binary choice logit model (see detailed results in [44]). The binary dependent variable was constructed by categorizing positive individuals (i.e. those who marked 4 or 5 in the general attitude question) as one (1) and all the other individuals (i.e. those who marked 1, 2, 3 or do not know) as zero (0). The results from the logit analysis are summarized in Fig. 5. They indicate that the probability of finding an individual who is in support of wind energy decreases with age and income, while the

[13]Respondents were also asked about their attitude towards *increased reliance* on wind power in the Swedish energy system. The answers to this question were, though, very similar to those presented above and are therefore not reported here. See [36] for details.

education level of the individual does not have a statistically significant impact. The negative correlation between income and the probability of a positive attitude is somewhat unexpected, and is contradicted by the results from other studies [45–47]. One possible explanation for our result, though, can be that individuals with higher income put less weight on the positive employment effects associated with wind power installations. Specifically, unemployment rates are generally higher in low-income regions; here the attitudes towards wind power development can be more positive (ceteris paribus), not because of its benign environmental attributes, but because of perceived positive impacts on local employment. Clearly, more elaborate research on this issue is needed before less tentative conclusions can be drawn.

No support is found for the hypothesis that differences in attitudes vary with respect to own experiences of wind power installations. Individuals that reported that they have wind turbines in sight of their home or summer house did not appear to perceive wind power in a significantly different way compared to individuals without such experience. These results lend thus no support to the NIMBY hypothesis. Still, it should be clear that this is only a 'weak' test of this hypothesis. As was noted above, the NIMBY phenomenon (to the extent it exists) is likely to be particularly prevalent prior to the construction of a new wind mill.

Furthermore, the results show that people who regularly buy 'green' products are more likely to be positive towards wind power than those who do not. Wind power is a relatively clean electricity source [1], and people who act to protect the environment are also more likely to express support for wind power. However, our analysis also shows that people who are members of environmental organizations do not on average express a more positive attitude towards wind power compared to non-members. A partial explanation to this result can be that in the recent past the Swedish Society for Nature Conservation—one of the most significant environmental organizations in Sweden—was rather negative towards wind power due to the wind mills' negative impacts on natural and cultural values [5].

The survey was constructed so as to permit an analysis of how respondents view social choice in the energy and environment field, and whether these views affect their attitudes towards wind power. Two issues relating to social choice were examined.[14] The *first* issue dealt with the respondents' willingness to accept trade-offs between environmental quality on the one hand and economic benefits on the other. As was noted in Section 3, wind power is generally uneconomical in the absence of public support (either directly through subsidies or indirectly through taxes on competing power sources). One can thus hypothesize that the less people are willing to trade-off economic benefits (e.g. low electricity prices) for environmental benefits (e.g. reduced greenhouse gas emissions), the more likely they are to promote wind power. The results from the logit analysis suggest that this hypothesis cannot be rejected. People who are willing to defend the protection of the environment with little regard of the economic costs involved are more likely to express a positive attitude towards wind power than those who wishes to strike a balance between

[14]It is important to note that for each of these two issues, the respondents were confronted with four statements to which they were asked to indicate to what extent they agreed (on a scale ranging from 1 to 5). The answers were used to create indexes (thus ranging from 5 to 25), which were used in the logit analysis. Thus, the respondents were not categorized on an either/or basis. See [44] for details on the questions posed to capture the respondents' preferences in each of the two cases.

Table 3
Public perceptions of the environmental impacts of different power sources

Electric power source	Low impacts on the environment (%)[a]
Electricity from combustion of biomass	55
Electricity from combustion of coal	2
Electricity from combustion of natural gas	47
Electricity from combustion of oil	3
Nuclear power	55
Solar power	93
Hydropower (existing capacity)	93
Wind power	88

[a]The column shows the percentage of the respondents who marked 'yes' on the question: 'Do you perceive the following electric power sources as environmentally benign?'.

economic and environmental goals and thus are more willing to give up environmental benefits for lower electricity prices.

The *second* issue relating to social choice in the energy sector dealt with the respondents' view on private versus public choices. A distinction was here made between those who expressed support for the idea that the political system should form the basis for decisions on the introduction of 'green' electricity in Sweden, and those who believed that the market mechanism—through consumer demand—should determine the extent to which 'green' electricity was introduced in the Swedish energy system. The results from the logit analysis indicated that the more people stressed the importance of the political system, the more likely they were to express a positive attitude towards wind power. This effect was, however, not statistically significant (see Fig. 5).

4.2. Attitudes towards the different attributes of wind power

Energy policy documents typically stress the environmental advantages of wind power compared to other power sources, but a lot of the opposition towards wind power has rather targeted different negative attributes of wind power such as visual intrusion, noise pollution and impacts on the flora and fauna. In this section, we first consider how the respondents perceive the overall environmental impacts of wind power compared to those of other power generation sources. We then present the results from a so-called choice experiment whose aim was to elicit the respondents' preferences towards the different attributes of wind mills (e.g. height, location, noise level, costs, etc.).

The results from the question about the environmental impacts of different power sources are summarized in Table 3. Coal fired power is considered to be an environmentally benign electricity source by only 2% of the respondents while as much as 93% express that existing hydropower and solar power are environmentally friendly electric power sources. Wind power is considered a benign source by as much as 88 percent of the respondents. This indicates a rather strong support among the public for the Swedish energy policy stance on wind power. A follow-up question indicated that one important positive environmental attribute of wind power is—according to the respondents—its renewable characteristics. However, given this it is somewhat surprising

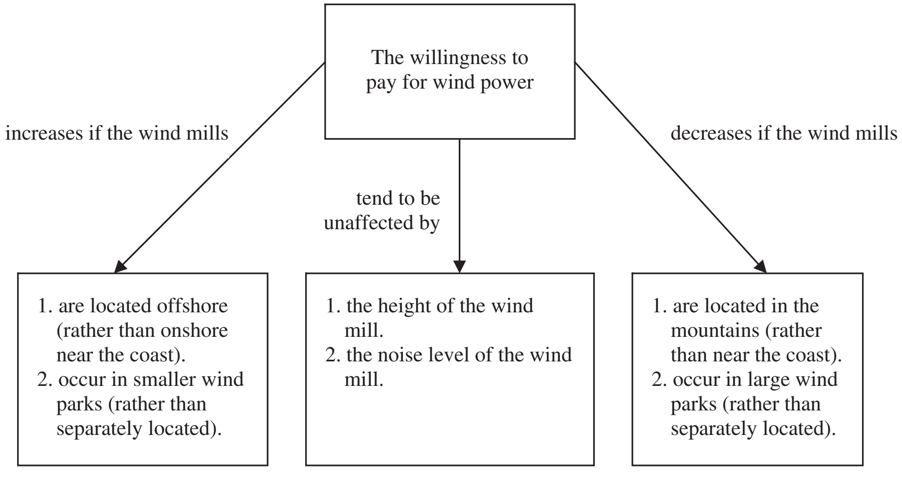
that the respondents are much more reluctant to view biomass-based electric power—which also is renewable—as environmentally benign.

The aim of the choice experiment was to examine the relative importance of different environmental characteristics associated with wind power.[15] When the attributes included in the experiment were selected, the results from previous research efforts constituted an important input [40,48–50, p. 75]. According to this research, the amenity effects are of major importance for the public's perception of wind mills. The attributes included in the experiment that aimed at capturing the attitudes towards the visual impacts from wind power installations were the location (e.g. onshore versus offshore), the height and the grouping of windmills (e.g. wind parks versus separately located wind mills). In addition, a noise attribute and a cost attribute (i.e. changes in the electricity price) were also included in the choice scenario.

In the experiment, respondents were asked to choose their most preferred between two alternatives of wind power, A and B, each associated with a bundle of different environmental attributes and prices. The attributes in alternative A varied while alternative B was identical among all choice sets; alternative B was designed so as to reflect as closely as possible the typical attributes of existing wind mills in Sweden and there was no change in the electricity price. The levels of the location attributes were: 'offshore', 'onshore near the coast' and 'in the mountains'. The height attribute had two levels, the most common height of Swedish wind mills (about 60 m high) and higher turbines (about 100 m high). Three levels for the grouping alternative were included: 'separately located wind turbines', 'small wind parks (less than ten windmills)' and 'large wind parks (between ten and fifty windmills)'. In order to permit an analysis of how Swedish house owners perceive the noise pollution arising form wind power generation, the highest level allowed outdoors in residential areas in Sweden (40 dB) was chosen as one level while the other represented a reduced level of noise (30 dB). Finally, the cost attribute included was a varied electricity price. Since it cannot be assessed ex ante whether some of the included attributes should be perceived as improvements or deteriorations compared to the typical attributes of the present capacity, the price attribute included price increases as well as reduced electricity prices. In order to make the choice task easier, the different levels were briefly described together with some reference levels. For instance, a few examples of objects that generates noise of about 30 and 40 dB were given in the text, the location alternatives were presented using colour pictures, and the price changes were complemented with a table indicating the total change in the yearly electricity bill for a typical household (with and without electricity heating).

The choice scenario was formulated so that it would mimic the decision that the respondent normally faces when choosing electricity supplier. In each choice set, respondents were asked the following question: "Given that you could only choose among the two alternatives below the last time you chose electricity supplier, which alternative, A or B, would you have chosen?". Since, the respondents in the survey could only choose between two different wind power options with different attributes, they were 'forced' to choose a wind alternative. The main motive for omitting the opt-out alternative is the political goal in Sweden to increase wind power capacity not the least through the

[15]For more details about the choice experiment referred to here, see [36], and for an introduction to choice experiments as an environmental valuation method, see [66,67]. A similar analysis of the environmental impacts of wind power in Spain can be found in [68].



* The variables that are outlined here as having an actual impact (whether negative or positive) on the (marginal) willingness to pay for wind power attributes, are those for which the implicit prices (based on the quota between the coefficient of a respective attribute and the price coefficient in the random effects binary probit model) were found to be statistically significant at the 10 percent level (or higher). See Ek (2002, Table 6.3) for details.

Fig. 6. Willingness to pay for different attributes of wind power in Sweden*.

mandatory green certificate system. In addition, the aim of this part of the study is to evaluate the attitudes towards the different attributes of wind power and the relative importance of these characteristics rather than how Swedish electricity consumers value wind power per se. The policy relevant issue examined here is, thus, how the introduction of more wind power capacity can be facilitated by altering its attributes and in this way increase the public acceptance of wind power.

The results from the choice experiment indicate that Swedish house owners are sensitive to the level of the price of electricity, but also to some extent willing to pay a premium for wind power with improved characteristics. Fig. 6 summarizes the findings from the choice experiment, and confirms previous research stating that the visual impacts seem to be of vital importance. Among the attributes included in the experiment, the location of wind mills appears to have the most important impact on the utility of the Swedish house owners.

Our results suggest that wind power located offshore is considered an environmental improvement while a location in the mountains is considered an environmental deterioration (compared to a location onshore near the coast). In addition, small wind mill parks are considered a change for the better while large farms are considered a change for the worse (compared to separately located wind turbines). Finally, according to our results reduced noise levels would increase the utility of the average house owner, but this impact was not statistically significant (see Fig. 6).

4.3. Final comments on public attitudes

The Swedish public, expresses a general, positive attitude towards wind power, and towards an increased use of wind power in the energy sector. These positive attitudes tend

to be correlated with a willingness to defend—and act on—environmental values. Compared to most conventional power generation alternatives, including biofueled power, wind power is also perceived as a particularly environmentally benign power source. This suggests that overall there appears to be a relatively strong support among the public for the Swedish energy policy objective to support increased diffusion of wind power. Still, this support for wind power is not always visualized at the implementation stage. Previous research finds limited support for the NIMBY syndrome, but also increasingly stresses the importance of public participation in the planning and localization process. The results from the choice experiment indicate a number of strategies that can be used to reduce any negative perceptions of wind power; in order to minimize the environmental disturbances, new schemes should primarily consist of smaller wind mill parks located offshore, while large wind farms onshore or in the mountains should be avoided. Thus, even though offshore wind power generally is more expensive than land-based mills (see Table 2), this may be offset by the lower risk of public opposition for offshore installations. Finally, while wind parks offshore typically are preferred over onshore parks, the resistance towards *large* wind parks in general may limit the prospects for major wind power expansion in Sweden.

5. Legal preconditions for establishing wind mills in Sweden

The diffusion of wind power in Sweden, and in turn the possibilities to fulfil national energy policy objectives and international climate policy commitments, are largely conditional upon the requirements of the law. Of particular interest are the systems of rules governing the assessment of the impacts of wind mills on the surrounding environment. Since, the above rules are designed to address a great variety of interests, both those related to certain exploitation purposes (e.g. fishery and industrial development) and those concerning the conservation of land and water in order to promote biodiversity and outdoor recreation, they may act as essential restrictions to an efficient implementation of wind power in Sweden. In this section, we analyze—not the least by consulting case law—the importance of these potential obstacles. Details on the court cases referred to in the following text are summarized in the Appendix.

Before proceeding, however, it is important to comment briefly on a basic question, namely who has the right to exploit the wind energy resource? Swedish law does not provide any specific rules regarding wind or other renewable energy resources, but it follows from the basic rules vis-a‘-vis the ownership to land, that the land-owner has the right to use the wind during the period of time the resource is within the borders of his or her property [51]. Expropriation of private property in order to extract wind energy is thus not legally provided for at the present. The legal situation is somewhat specific as regards ‘common water areas’. These encompass the larger part of the territorial sea as well as the four greatest lakes in the country. Common water areas are not owned by private persons, neither are they generally owned by the State. Specific legislation provides exclusive rights for the State to extract certain natural resources (e.g. minerals), but these rights do not include access to wind resources. Thus, the State may not—on the basis of ownership law—prevent anyone from using these areas for localization of wind mills or impose charges on such an investor [51]. The right to extract wind energy in the common water areas is not subject to any specific regulation. However, common water areas as well as other land or water areas are subject to a number of restrictions based on public law, and

from this perspective ownership is not a relevant issue. In the remainder of this section, the most significant public law restrictions are addressed.

5.1. Environmental requirements based on the Environmental Code

According to the Environmental Code, big and medium-sized wind mill installations may not be constructed without one or several licenses. A license may in turn only be issued if the proposed project complies with certain environmental requirements. The most important of these are the general and specific 'resource management provisions', and the localization requirement.

5.1.1. Resource management provisions

A broad implementation of wind power requires access to sizeable areas with a more or less constant supply of wind. However, since these types of areas often are scarce, the competition of use is intense and conflicts of interest frequent. The management of Swedish land and water areas is regulated in the Environmental Code; there exist basic and special resource management provisions, and both are of interest for wind power implementation.

The basic resource management provisions function as guidelines for the overall use of land and water areas in Sweden. The general principle in Section 1 in chapter 3 provides guidance for the assessment of conflicts of interests, stating that "priority shall be given to use that promotes good management from the point of view of public interests", something which implies that the interest of the public shall take precedence over any private interest (even though a combined use should always be considered) and that a long-term perspective should be put on all use of land and water areas. The assessment should furthermore be undertaken in the view of the general provisions (i.e. the sustainability objective) of the Environmental Code. The extraction of wind energy is thus not given specific priority by this principle. Even so, the prioritized position given to public interests in relation to private ones may, in exceptional cases, promote wind power. Still, the situations in which the wind energy interest enters into competition with other (long-term) public interests are perhaps more common. For these situations, neither the guidance given by Section 1, nor the general provisions of the Environmental Code provide enough guidance for the assessment of the conflict of interests.

In addition to the general principle, different types of land and water areas are regulated, and the corresponding provisions aim at protecting a specific interest connected to the area. For instance, Section 8 in chapter 3 aims at protecting areas suitable for wind power extraction and other forms of energy production, and Section 6 aims at protecting areas of interest for nature conservation and outdoor recreation. The different interests should 'as far as possible' be protected against activities that can considerably *affect* or *damage*, for instance, the character of an area, or considerably *obstruct* or *counteract* the use of an area.

The above rules are, generally, formulated, providing a lot of space for interpretation regarding the legal application as well as the actual content of the provisions [52]. For instance, assume that a municipality wishes to construct a recreational park in an area suitable for wind power purposes. According to the law special attention should be paid to the need for green areas. In this case, thus, the area is valuable due to two legally 'protected' interests. A combined use should be considered, but if that is not possible the starting point for the assessment is the very vague general principle outlined above. Now

assume that the area has been selected as a *national interest* for wind power production. This is a special legal situation where, normally, the area 'shall be protected'. In this case, the wind power interest has a stronger position than the park since no weighting of interest needs to be undertaken. Whether the area is in fact of national interest for wind energy extraction is ultimately, however, a matter for the Environmental Court to decide; government agencies may not in legally binding terms decide upon this issue. Finally, assume that both the wind area and the park area are of national interest. In this case, the law provides a special rule for assessment, which states that precedence shall be given to the interest that best promotes a long-term resource management. This provision is, however, as weak as the above general principle.

The above examples illustrate that when consulting the legal text (and the preparatories), it is very difficult to foresee to what extent wind mills will be accepted in the permitting processes. An analysis of case law can shed some additional light on this issue. One case concerned offshore wind mill installations in an area of importance as a bird migration track (Case M 833-99). The matter to decide was therefore whether the wind power interest (on this particular site) could be considered important enough to outweigh any possible negative impacts on birds. The Environmental Court of Appeal concluded that the risk of negative impacts on birds was difficult to assess, but that the current knowledge regarding this matter indicated that wind mills in general were not likely to cause any serious negative impact on bird life. The government shared the Court's assessment and decided that the establishment should not be prevented on the grounds of the basic resource management provisions.[16]

In two other cases, the installations were planned in areas appointed as national interests for nature conservation and out-door life (CasesM 9540-99 and M1391-01). The mills were found to have some impact on the overall picture of the landscape, but since the areas were already to some extent exploited by previous industrial activity, the Court did not find the installations to cause any considerable damage to the protected values and they were thus not prevented by the provisions. Yet another case concerned the establishment of two additional turbines to an existing wind mill park (Case M 623-02), and in a related case a single turbine within the same area was planned (Case M 7625-00). The Court found that all these installations were in non-compliance with the general provision due to expected noise pollution (two of the turbines) and negative impacts on the view of the landscape (all three turbines).

In sum, the prerequisites for wind power production provided by the basic resource management provisions are unpredictable both regarding the possibilities to avert obstructive activity and to promote wind power. The extensive room for weighting in the assessment provided by the provisions, therefore, implies a need to distinguish and strengthen the weight given to the wind interest. The legal system does provide possibilities to apply the provisions in favour of a broad wind power implementation, given that areas are in fact appointed as being of national interest ('riksintresse') for the purpose of wind energy extraction, something which in turn calls for a throughout delineation of areas suitable for wind power establishment. Since the approval of the 2002 Government Bill on

[16]If a case is found to relate to yet another area of public interest of great importance than those referred to in the Environmental Code, the Environmental Court should turn the case over to the Government together with its own opinion. In this particular case both the bird migration track and the exploitation interest were found to be of great importance.

energy policy (see Section 2), such work has been initiated and is now ongoing (see, for instance, [53]). Our analysis suggests that this is an important step towards increasing the share of wind power in the Swedish energy system.

As was noted above, in addition to the general resource management provisions, chapter 4 of the Environmental Code outlines also special resource management provisions. These protect geographically delimited areas of national interest for their natural and cultural values from exploitation activities and other interferences in the natural environment. Such an area is *in its entirety* of national interest, which implies that the weighting has already been made and that, in a competitive situation, precedence shall be given the protected interests. Wind mills can only be established in these areas if they: (a) *meet no hindrance* by the area provisions; and (b) do not *considerably damage* the protected values. In the assessment of whether an activity is likely to cause considerable damage or not, it is the *total* natural and cultural values in the entire protected area that are intended. This implies that even if parts of the protected areas were to be considerably damaged by a proposed activity, the rule may not prevent the activity unless the *total values* of the area are affected.

Some exceptions from this general prohibition are provided. The first exception applies to 'the development of existing built-up areas' by which is intended development required to meet normal population growth (i.e. buildings, roads, parks, service, etc.). Wind mills may be of interest in these cases if providing electricity to new residential areas, retail trade and smaller industries. Another exception applies to the development of the local industry, which refers to economic growth in either existing or new economic sectors required to meet the need for employment. Since, the establishment of wind power provides employment opportunities in both the establishment phase (building and construction work) and the running phase (monitoring and controlling) also this exception may work in favor of wind power development. Still, the importance of the special area provisions, and their bearing on the possibilities to establish wind turbines, are best illustrated by case law examples.

For some areas, the interest for outdoor life and tourism should be taken into account when assessing the possibilities for establishment. In a case regarding the building of 12 wind turbines in such an area (Case M 144-01), the regional Environmental Court found 'the visual intrusion of the turbines to strikingly change the character of the unbroken mountain area', and this would considerably damage the protected values. The establishment was thus prevented. In order to preserve the landscape characteristics, certain areas with unbroken coastlines are protected. A number of new activities and operations, specified in law, are explicitly prohibited, there among 'wind farms consisting of clusters of three of more wind turbines with at total output of not less than 10 MW'. The establishment of smaller systems (<10 MW) is thus not explicitly prevented, but the overall protection of these areas against industrial activity is rather strong.

Areas with already highly exploited coastlines, still basically untouched nature areas are protected from further interference in favour of recreational purposes. In these areas, wind turbine establishment is not explicitly prevented by the special provisions and the question is thus whether the establishment can take place without causing considerable damage. In 2001 and 2002, this issue was subject to assessments by the Environmental Court of Appeal in three wind mill cases. In the first case (Case M 8328-99), the application for permit was declined since the establishment of the wind turbines 'was to cause considerable damage to

the very high environmental values in the area'. The Court found that the turbines were to dominate the landscape and abolish the impression of unexploited nature in that particular part of the coastline. In the second and third cases (Cases M 9540-99 and M 1391-01), the Court concluded that the wind turbines would affect the view of the landscape, but since the current areas were already exploited the planned turbines were not likely to cause considerable damages to the present values. Still, in the end these projects were not approved due to the localization requirement (see below).

Just as the basic resource management provisions, the special resource management provisions leave the authorities with substantial room of discretion, not least by the provided exceptions, which makes the outcomes rather unpredictable. An important observation is also that although national energy policy promotes wind power due to its environmentally benign attributes, the legal framework governing the permitting and localization procedures do not appear to take any explicit account of these benefits.

5.1.2. The localization requirement

Activities and measures that involve the use of land or water areas are subject to the socalled localization rule, according to which requirements regarding the selection of sites can be brought upon operators (which then are obliged to demonstrate compliance with the requirements). Two issues are of particular concern. First, for activities and measures other than just temporary, the selected site shall be *suitable* with regards to the objectives of the Environmental Code and the resource management provisions. Second, for *all* activities and measures, sites shall be selected in order to achieve the purpose of the activity with a 'minimum of damage or detriment to the environment'. The latter requirement obliges the operator, in controversial cases, to undertake an objective (i.e. irrespective of access to the sites in question) assessment of alternative sites in order for the chosen location to be the most appropriate from an environmentally point of view. The localization rule is probably one of the most significant legal obstacles towards wind mill establishments in Sweden, and also here it is useful to illustrate the problems by consulting some important case law examples.

In four cases handled by the Environmental Court of Appeal, the localization assessment determined the outcomes. In two of the cases (Cases M 9540-99 and M 1391- 01), the Court came to the conclusion that the operators' assessments of alternative sites were not sufficient (they were in fact lacking), something that, especially considering the intense competition for land areas and the fact that the municipal and the county administrative board in both cases had recommended a rejection of the application, is an imperative demand. The appeals were therefore rejected. The other two cases concerned the localization of three turbines of which the selected site for the first two (Case M 623- 02) was considered unsuitable due to disturbances for the neighbors and due to negative impacts on the view of the landscape. The selected site for the last turbine (Case M 7625- 00) was also found unsuitable, due to disturbance and security issues.

The localization requirement can thus be shown to have hampered the establishment of wind mills. The requirement to *objectively* assess alternative sites may in some cases imply a very significant—and even inefficient—obstacle towards establishment; the wind mill owner may not have access to any other site than the one appointed, but if another site is found to better achieve the purpose of the activity from an environmental point of view, a permit can not be issued unless the costs for altering location are found unreasonable.

5.1.3. Additional environmental requirements

Although the resource management provisions and the localization requirement are the most crucial legal provisions in connection with the establishment of wind mills, a few others require attention as well.

Occasionally, a situation may arise where a site for a proposed wind mill is approved in accordance with the above mentioned provisions, but the impact on health or the environment is still considered to be 'significant'. The project is then prohibited unless the government finds that opposite interests clearly outweigh the negative impacts of the establishment. Furthermore, since operators are obliged to use [the] 'best available technology', courts have in some cases approved a localization which is not proved to be the best from an environmental point of view, and instead required the use of an extra efficient technology for reducing any environmental impacts. As a consequence, and even though the technology requirement does not directly prevent the project, the resulting cost increase may in practice force the operator to choose not to commence with the project. Moreover:

- Very large wind mills (R10 MW) must initially be approved by the government. In these cases, municipalities have possibilities to stop the projects, using a veto. The government may only very occasionally overrule this municipal veto.
- Environmental quality standards, e.g. limits related to noise in an area, normally prevent the establishment of wind mills if the limits are exceeded.
- If an area is set aside for other land use purposes in detail plans or area provisions according to the Planning and Building Act (see Section 5.2), wind mills may not be permitted in accordance with the Environmental Code.

Finally, wind mill projects in water areas are subject to additional special provisions related to water operations: "water operations may only be undertaken if the benefits from the point of view of the public and private interests *are greater than the costs and damages* associated with them," (emphasis added). This social cost-benefit rule was applied by the Environmental Court of Appeal in a case regarding offshore establishment of seven wind turbines (CaseM833-99). The main question here was what were to be included in the cost-benefit assessment. The Court came to the conclusion that the state subsidies granted to wind power establishment at the time (i.e. the investment subsidies and the environmental bonus) were to be regarded as benefits from a public point of view (i.e. an adapted economic value) in the weighting process. The subsidies reflect, it was argued, the implicit value of attaining an increased share of renewable energy. The Government shared the opinion of the Court and concluded that the increased supply of renewable energy as a result of the establishment was in compliance with the national environmental objectives and would in this case exceed the costs and damages that the activity may cause. The above statements by the Court and the Government could prove to be important for the future of offshore wind power in Sweden. This case illustrates how the wind power interest—as a mean to achieve important national (and global) policy goals—can be visualized at the implementation stage and weighed against any local damages caused by the development. Similar legal approaches are however lacking in the case of wind power located onshore.

5.2. Territorial planning based on the Planning and Building Act

Even if a wind power project passes the legal hurdles outlined in the Environmental Code, the project must also assent to the territorial planning provisions of the Planning

and Building Act. A special building permit is required and, more importantly, the municipalities adopt different kinds of territorial plans that may significantly influence—and sometimes legally determine—whether or not a wind mill could be located at a specific site. The prerequisites for wind power implementation in accordance with these provisions do in principle not diverge from the requirements for other buildings and installations. The planning process includes balancing between different interests and it is mainly a matter for the municipal planning authorities.

The Swedish planning system has a significant influence on the possibilities for a broad implementation of wind power, not the least since it in principle implies that the municipality must in some way assent to (i.e. plan for) the establishment of wind turbines on a certain location in order for the establishment to actually take place. The Planning and Building Act also includes a special planning requirement stating that for certain buildings and installations to take place a 'detailed plan' must be established if, for instance, the new building 'will have a significant impact on the surroundings', something which often is the case for wind mills and wind parks. Furthermore, even if the establishment of wind turbines is planned for (i.e. laid down in a detailed territorial plan), there are no guarantees that the establishment will actually take place; detailed plans do *prevent* activities that are in non-compliance with the plans, but they do not explicitly *promote* the establishment as such. For instance, in the case of wind power implementation areas planned for other purposes will prevent the establishment of wind turbines, and in areas where turbines are in fact planned for the wind mill investment may still be hindered by, say, the localization requirement. The decision whether to adopt a detailed plan lies within the competence of the local municipality (see also Section 6).

The rather vague balancing principles provided for by the Planning and Building Act thus leaves a substantial room for discretion on the part of the local municipalities. However, the State (represented by the County Administrative Board) shall reject municipal plans under certain circumstances. Accordingly, areas of *national interest* for wind energy extraction in accordance with the management provisions in the Environmental Code are subject to some governmental control. If, for instance, a windy valley has been appointed national interest for wind power and the adopted detail plan does not comply with this interest, the County Administrative Board is required to reject the plan. It is also the duty of the Board to strive to implement the national interests in the overview planning, but in the end it is a matter for the municipalities do decide whether to take the advise of the Board or not.

Also in practice, the strong municipal influence on the use of land and water areas in connection with physical planning has shown to be of central importance for the prerequisites for wind power implementation. The courts pay attention to the municipal planning when deciding upon permits, especially if the competition for land areas is intense. A statement by the Environmental Court of Appeal strengthens the conception of a municipal monopoly in the field of physical planning:[17]

> "In the light of the leading role played by the municipalities in the physical planning process, the position taken up by the municipalities carries great weight in the adjustment made by the courts in accordance with the management provisions and reasons to make other priorities regarding the use of land and water areas should

[17]Judgement of the Environmental Court of Appeal (21 June 2001) in case M 1125-99. This particular case regarded a permit application for the establishment of a non-wind power station, but similar writings can be found in cases regarding wind power establishments. See, for instance, cases M 9540-99, M 1391-01 and M 623-02.

normally only be the case if opposite regional or national interests make themselves heard.'' [authors' translation].

5.3. Final comments on the legal preconditions

In this section, we have argued that the legal protection against activities with a negative impact on the surroundings (i.e. the view of the landscape), such as the establishment of wind turbines, is strong in Sweden. The basic and special resource management provisions as well as the localization requirement in the Environmental Code tend often to hamper wind mill installations. From an investor perspective, this legal situation gives rise to important uncertainties about the economic outcome of a proposed project; even though the project is granted permission the duration of time between investment decision and approval may be considerable. If the renewable (or perhaps even wind) energy interest were laid down and specified in the basic management provisions with the possibility to appoint areas as being of national interest for this purpose, it should greatly reduce these type of uncertainties and thus facilitate-although not entirely ensure-future development. Finally, the different territorial plans strongly affect the possibilities for wind power implementation, and the local municipalities play a crucial role in this planning process. The plans are of central importance in the permission-trial for wind mill establishment in accordance with the Planning and Building act and the Environmental Code. On certain conditions, the Courts are restricted by the content of the plans and in other cases the plans serve as important bases for decisions. The municipal right of veto in connection with the governmental licensing is yet another example of the extensive decision powers provided to the municipalities. In Section 6, we discuss in more detail—based on previous empirical research—the consequences for wind power development of this high degree of local autonomy.

6. Global policies and local autonomy: consequences of the municipal planning monopoly

In Section 5, we emphasized the important role of local municipalities in influencing the establishment of wind mills in Sweden through the territorial planning process. Swedish municipalities are, however, also confronted with the Law on municipal energy planning, according to which every municipality is obliged to have an energy plan for its entire energy system covering energy demand, energy supply and energy distribution within the municipality. The energy plan should reflect national energy objectives as well as the objectives of the municipal energy policy. Nevertheless, the freedom of choice left by this law is extensive; the municipalities are free to make other priorities than energy conservation in the planning decisions, and the law does not provide rules either to force accomplishment for the case the municipalities ignore the energy plan requirement or to retrial an inappropriate energy plan. Finally, even if a municipality establishes an ambitious energy plan, it has no legal effect and may therefore be neglected by the municipality in future decision-making. This strengthens our conclusion that local priorities may play an important role in determining wind power planning outcomes, creating a risk for overseeing national and global energy policy objectives.

The 290 different Swedish municipalities are confronted with different preconditions with respect to natural resource supply, economic development, unemployment, etc.

together with various political ambitions and energy policies, something that, in view of the above, may create strong incentives to make other priorities than those indicated by the overarching energy policy objectives. All in all, the strong municipal position constitutes a system which lacks confidence for a broad wind power implementation and leaves a substantial room for discretion and for de facto ignoring national (and indeed global) energy policy objectives. Still, it remains an empirical task to determine whether this legal situation and the competences allocated through the law tend to make important differences in practice.

This section analyzes the practical importance of the 'municipal planning monopoly' in actual wind power siting situations. Specifically, Section 6.1 makes use of the results from recent empirical research, and discusses to what extent the existing legal framework governing the permitting and planning of wind mills hamper the efficient introduction of wind power in the Swedish energy system. In Section 6.2, we analyze the most important policy implications that follow from these findings.

6.1. Differences in planning strategies: examples from three municipalities[18]

Swedish governmental investigations have highlighted the key role played by local governments in the development of—primarily land-based—wind power, and that given the existence of an ambiguous national policy towards wind power this role has become even more accentuated. For instance, in SOU (1998:152) it is noted that in the past the attitudes of local governments towards wind power development have differed markedly, and that this fact has often significantly determined the outcome of the permitting procedure (see also [53]).

Khan [54] provides a more systematic—and recent—analysis of these issues. He examines empirically the influence of the planning strategies employed in three different Swedish municipalities on the respective wind power developments. His main interest lies in examining how these strategies have impacted on the siting of turbines, but also on the ownership of turbines built and the role of citizen participation in each municipality. The three municipalities under study—Laholm, Halmstad and Falkenberg—are of similar size, possess roughly similar wind conditions and landscape characteristics, but in terms of wind power development the outcomes differ a lot. Most notably, in Laholm, 45 wind turbines (totalling 22 MW) are installed, while only five turbines (2 MW) have so far been developed in Halmstad. The author proposes that the extent to and the way in which territorial planning requirements have been implemented largely explain these differences.

What is most evident is that in Halmstad and Falkenberg, the local authorities have assigned areas as suitable for wind power development (while, as a consequence, the remaining areas are freed from wind power investments). However, in these municipalities detailed physical plans are required for all wind power projects, something which makes it easier for the local government to influence and determine the characteristics and the size of the proposed projects. One important reason for why the outcomes in these two

[18] Section 6.1 builds heavily on the research conducted by Jamil Khan, Lund University, Sweden, as reported in [54]. See also [69].

municipalities have differed is the attitude towards wind power expansion among officials and local politicians. Khan [54, p. 573] notes:

> "In Halmstad, the planners had a rather detached view concerning wind power and have seen it as one land use interest among others. In Falkenberg, where there was strong political support for wind power, the planners have viewed planning partially as a way to support wind power."

In contrast to the experiences in the above municipalities, the politicians in Laholm were positive to wind power development and at the same time reluctant to demand detailed planning for wind power. While this approach has tended to create a favourable investment environment for small-scale wind developers (primarily farmers), it has also contributed to a rather 'scattered' wind mill location situation rather than to investments in more concentrated areas. An important drawback of this policy approach has therefore been the growing public opposition towards new mills, partly as a result of the uncoordinated mill siting process and the lack of citizen participation [54].

Khan [54] also concludes that the choice of planning approach influences the structure of economic ownership in wind power projects. This issue is important since local involvement in such projects can effectively increase the acceptance of wind power. The soar in wind power production in countries such as Denmark and Germany is often attributed to the high degree of local ownership either directly through cooperatives or indirectly through local shares in the investment project [55]. In his analysis, Khan [54, p. 574] concludes that in Halmstad where the planning process has been relatively strict (e.g. detailed plan requirements):

> "[l]arge land owners and wind power companies will be favoured while smaller land owners and co-operatives will find it harder to build. […], the areas that have been identified as suitable for wind power are those with surrounding residential buildings and, for historical reasons, they are generally owned by large land owners. […]. [Moreover], the focus on large projects means that the costs of the [detailed plan] and the environmental application will become significant, which makes it more difficult for smaller actors to afford them."

As a result, in Laholm, such requirements did not exist and the local government even actively facilitated small-scale projects, enabling farmers to invest in single turbines. In Falkenberg, the local government combined the use of strict planning requirements while at the same time supporting local ownership. The largest wind mill project in the region was developed and financed by the municipal energy company, which then offered shares to local companies, co-operatives and individuals [55].

The analysis in Section 4 of this paper showed that the general public typically considers wind power environmentally friendly, but somewhat ironically most of the objections to its expansion tend to have had environmental origins. In addition, in Section 5 we emphasized that the environmental legislation conditioning wind power development in a certain region tends to be vague, and provides plenty of room for opponents to delay and even hamper mill installations. At the implementation stage the overall environmental benefits of wind power are not always visualized. Increased citizen participation could however provide a solution to this dilemma, not the least by improving the acceptance and legitimacy of decisions. Local governments in Sweden are obliged to consult affected individuals and organizations in the planning process, but they are left with considerable

freedom to decide in what way citizen participation should be carried out. In his analysis, Khan [54] concludes that the way in which citizen participation is integrated into the planning process may differ a lot across Swedish municipalities.

We have already noted that in the case of Laholm, citizen participation was very limited. The lack of detailed planning for wind power helped to limit such participation for specific projects, and the local government did nothing to actively encourage local opinions to make their voices heard. In the two other municipalities—Falkenberg and Halmstad—detailed plans are required and citizen participation tends to be more extensive, although not free from problems. In general, there has existed difficulties in promoting citizen participation early in the decision process, i.e. prior to the development of the project plan or even the installment of the mill itself. Khan [54] also argues that the motives behind promoting citizen participation tend to differ; in Falkenberg citizen participation (although limited in reach) is seen as an important input in shaping project plans, while in Halmstad—where planners and politicians often have been sceptic about wind power—the "focus on citizen participation has been one way for the local government to prolong the planning process and shift the responsibility for decisions on the citizens," (p. 577).

In sum, Khan's result suggest that in municipalities where there exist a political will to promote wind power and thus to integrate efficiently the diffusion of wind mills into the planning process, the planning requirements have often been flexible and relatively simple. Important drawbacks of this approach, however, are that it may not promote an efficient siting of wind mills and it tends to limit the role of citizen participation. Thus, while successful in the short-run such a planning approach may create suspicion towards wind power technology in the longer run, and in this way deter future development. In municipalities in which politicians are more reluctant to actively promote wind power, the planning requirements have been stricter and citizen participation more extensive; as a result, the installed capacity of wind mills is low [54].

6.2. *Important implications*

A number of implications follow from the research effort reviewed in the previous section, and it is useful to analyze three particularly important implications in somewhat more detail.

First, the above cases illustrate that the Planning and Building Act does not as such constitute an obstacle to wind power development; on the contrary, the planning requirements can be used efficiently to promote wind power with minimum disturbances on the community and, as a result, continued public support. The main problem lies instead in the fact that the legislation leaves so much room for discretion; in municipalities with excellent wind conditions but a non-existing political will, the planning requirements may easily be used to hamper development activities. From the point of view of a wind power investor this implies considerable uncertainties about the investment environment. Even though the economic support is the same across the country, the legal obstacles may differ considerably between municipalities. Our point is not that the legal requirements should be the same across the entire country; they are designed to address local circumstances and in this way they serve a good purpose. However, Khan's study shows that the differences between various municipal planning requirements can to a large extent be explained by differences in the attitudes of politicians and local government officials. For the investor this also means that the obstacles to develop wind power may vary

substantially over time as political majorities change and officials are replaced. In the absence of binding national planning goals—which essentially exist in Denmark and Germany—wind power will always run a substantial risk of facing significant local obstacles to its implementation and its contribution to the fulfilment of national energy and environmental policy goals will not be paid enough attention.

Second, given the above empirical findings it is also worth noting that the municipal planning monopoly tends to undermine one of the goals of the recently introduced green certificate system. As was noted in Section 2, the certificate system is designed so as to promote a cost *efficient* introduction of renewable power technologies. However, this goal cannot be accomplished unless the planning approaches of Swedish municipalities are in some way harmonized. As shown above, in practice the local policies towards wind power siting projects tend to differ on grounds that cannot be attributed to important environmental and/or economic circumstances. For instance, the territorial planning legislation does not in any way ensure that investments in wind power take place at sites with superior wind conditions. This leads to the important conclusion that the Swedish green certificates system constitutes (at best) a necessary but not a sufficient condition for ensuring a cost efficient deployment of renewable power.

Third, the role of citizen participation is complex; while it may hamper projects in the short run—due to delays in the permitting process—it is necessary to increase legitimacy and ensure an efficient implementation of wind power in the long run. This issue is made even more complicated by the fact that the Swedish public tends to provide a lot of support for the national energy goals concerning wind power (Section 4), but at the local community level other goals can easily be—and indeed often are—put in the foreground. It is possible to identify two strategies for the solving of this dilemma. One would be to increase the level of local stakeholders and ownership in the wind mill projects. This has proved to be an efficient strategy in other European countries. Toke [56] compares the impact of ownership on wind power instalation in Denmark and the United Kingdom. He concludes that in Denmark local co-operatives own a large share of the windmills installed, and this has proved to be an effective way of enforcing an ambitious central wind promoting policy while at the same time avoiding local opposition. Reiche and Bechberger [17] report that in Spain a wind power investor may often be required to support regional economic and social welfare as a part of the permitting conditions.[19] Systematic use of means to promote local participation in wind power projects is generally lacking in Sweden; it is worth noting that before 1991 it was not even possible for small, private investors in Sweden to attain public economic support for wind mill investments, while such support has been existing in Denmark since 1979 [57].

Another strategy to avoid land use conflicts and related public criticism would simply be to install the mills out of view, preferably offshore. As was indicated in Section 4, from a public perspective, offshore instalments tend to gain more public support than corresponding investments onshore, primarily since the aesthetic and noise-related intrusion is often perceived as less severe. The conflict of interest between national energy policy priorities and local implementation appears also to be less of a problem in the case of offshore wind. In addition to avoiding the removal of land from other competing uses, offshore installations offer some operational advantages. The wind conditions are

[19]This Spanish policy also creates, however, an additional financial hurdle for wind power developers.

generally better, but so far this is offset by the higher capital costs associated with offshore investment. Still, in spite of this new wind power projects—in Sweden and abroad—are increasingly planned offshore [58]. This paper has illustrated that the investment uncertainties related to land use conflicts and public opinion at the local level provide important explanations to this development.

7. Concluding remarks and implications

In this paper, we have provided an economic assessment of the potential for future wind power investment in Sweden in close conjunction with an analysis of the investment uncertainties related to legal, political and attitudinal factors. Our results show that the existing and planned policy instruments intended to promote wind power are generally strong enough to make wind power projects competitive. However, the economics of wind power is very strongly affected by investment uncertainties related to: (a) a lack of policy stability; (b) public criticism at the local level; and (c) the legal provisions governing the assessment of the environmental impacts of wind mills and the planning procedures for mill location in Sweden. In the energy sector, it is generally true that one of the few stable policy parameters is environmentally related; power projects that are environmentally benign will always tend to be favoured in some way or another [9]. However, the irony in the Swedish wind power case is that not even the environmental argument seems to work in favour of wind. While the general public, national and global energy policies, and indeed many scientists all point out wind power as particularly environmentally friendly, most of the objections to its expansion tend to have environmental origins. The interests of those who object to wind mill installations at the local level gain strong legal protection and the municipal territorial planningmonopoly implies that it is hard tomakenational energy policy goals visible at the local implementation stage. While this type of dilemma is a reality for most new investment in power generation technologies, the wind power example is likely to be one of the most striking, and, equally important, wind power is the technology that tends to have the most to loose from the uncertainties created by this investment environment.

In the search for a solution to this dilemma one would ideally be looking for a situation in which individuals (or perhaps even local governments) were placed under 'a veil of ignorance' (see [59]) to agree upon whether wind power should expand in Sweden or not, but without knowing if they themselves would be affected by this development.[20] The analysis in this paper suggests that this type of decision making process would likely lead to an expansion of wind power well beyond what we witness today, and help in reaching the current policy goal for wind power by 2015. The paper has—partly by drawing from the experiences in other European countries—identified and discussed a number of more pragmatic ways in which the national/global environmental interests at the local level could be strengthened. We have stressed the importance of citizen participation not only in voicing concerns about visual impacts but also in ownership issues and decision processes. It should, however, also be clear that citizen participation at the local level does not necessarily provide a universal solution; in those cases where involvement by the public tends to promote an inefficient diffusion of wind mills the long-run acceptance towards the technology may be hampered.

[20]We are indebted to Anders Biel for this apt metaphor.

Since the diffusion of wind power encounters the most strident obstacles where it interferes with competing land uses, a move offshore may be an efficient strategy for a wind mill investor (but not necessarily for society as a whole). Finally, if the renewable (or perhaps even wind) energy interest were laid down and specified in the legal provisions with the possibility to appoint areas as being of national interest for this purpose, the investment environment for wind power would benefit greatly. Unless there is such a clear political commitment to reduce the legal and policy-related uncertainties associated with wind power investment in Sweden, the government and electricity consumers in the country run the risk of spending a lot of money on technology support without getting much in return.

Appendix. Legal court cases referred to in the article

Cases	Institutional bodies involved	Summary of content
M 833-99	Decision and statement to the Government (17 January 2000) together with the decision of the Government (9 March 2000)	Offshore installation of seven wind mills; question of what was to be included in the social cost-benefit assessment in accordance with the Water Act (1983:291)
M 9540-99	Judgement of the Environmental Court of Appeal (31 October 2001)	Localization of two wind mills within the coastal zone. Trial in accordance with the Environmental Protection Act (1969:387) and the Natural Resource Act (1987:12)
M 1391-01	Judgement of the Environmental Court of Appeal (18 January 2002)	Localization of two wind mills within the coastal zone. Trial in accordance with the Environmental Protection Act (1969:387) and the Natural Resource Act (1987:12)
M 623-02	Judgement of the Environmental Court of Appeal (29 December 2003)	Permit to install and operate two wind mills. Trial in accordance with the Environmental Protection Act (1969:387) and the Natural Resource Act (1987:12)
M 7625-00	Judgement of the Environmental Court of Appeal (29 December 2003)	Permit to install and operate a single wind mill. Trial in accordance with the Environmental Protection Act (1969:387) and the Natural Resource Act (1987:12)
M 144-01	Statement of the Regional Environmental Court of Östersund (28 March 2003)	Permit to install and operate 12 wind mills. Trial in accordance with the Environmental Code (1998: 808)
M 8328-99	Judgement of the Environmental Court of Appeal (29 December 2003)	Localization of six wind mills. Trial in accordance with the Environmental Protection Act (1969:387) and the Natural Resource Act (1987:12)

All Acts referred to in the table form part of the Environmental Code of Sweden. The Swedish Environmental Code was adopted in 1998 and entered into force 1 January 1999. The rules contained within 15 acts were then amalgamated in the Code.

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